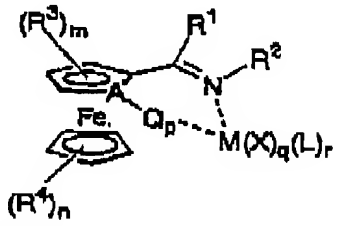
217688US0
10/022,772

What Is Claimed Is:

1. A transition metal compound represented by the following formula (1):



(1)

wherein M represents a transition metal atom selected from the group consisting of metal atoms of group 3 to group 12 of the periodic table;

X represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbyloxygroup having 1 to 20 carbon atoms, an amino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a sulfonate group having an organic residue with 1 to 20 carbon atoms, or a non-coordinative anion containing an element selected from the group consisting of B, Al, P and Sb, and, when q is an integer of at least 2, Xs may be the same as or different from each other;

A represents a carbon atom, a nitrogen atom or a phosphorus atom;

R^1 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one halogen atom, or a ferrocenyl group or a substituted ferrocenyl group;

R^2 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of halogen, silicon, nitrogen, oxygen and sulfur atoms, or a ferrocenyl group or a substituted ferrocenyl group; and R^1 and R^2 may form together a ring;

Q represents a hydrogen atom, a hydrocarbon group having

1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an amino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen and sulfur atoms, or oxygen or sulfur; and, when Q contains a coordinative atom, Q can be coordinatively bound to M;

R^3 represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, oxygen, halogen and sulfur atoms and one of R^3s adjacent to Q may form a ring together with Q; and, when m is an integer of at least 2, R^3s may be the same as or different from each other, and adjacent R^3s may form together a ring;

R^4 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen, halogen and sulfur atoms; and, when n is an integer of at least 2, R^4s may be the same as or different from each other, and adjacent R^4s may form together a ring; and R^3 and R^4 may form together a ring; and, when R^4 contains a heteroatom, R^4 can coordinate with the transition metal atom M;

L is a coordinate bond-forming compound selected from the group consisting of π electron, ethers, nitriles, amines and

phosphines, and L may be bound to X;

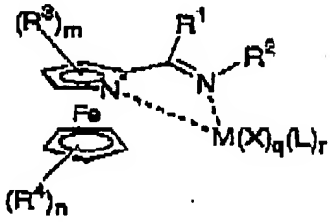
m is an integer of 1 to 3, n is an integer of 1 to 5, and p is an integer of 0 or 1;

when Q is sulfur or oxygen, the bond between Q and M is a sigma bond;

when p is 0 and A is a nitrogen atom or a phosphorus atom, A can be coordinatively bound to M; and

q is an integer of 1 to 3 and r is an integer of 0 to 3.

2. A transition metal compound represented by the following formula (2):



(2)

wherein M represents a transition metal atom selected from the group consisting of metal atoms of group 3 to group 12 of the periodic table;

X represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a sulfonate group having an organic residue with 1 to 20 carbon atoms, or a non-coordinative anion containing an element selected from the group consisting of B, Al, P and Sb, and, when q is an integer of at least 2, Xs may be the same as or different from each other;

R^1 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one halogen atom, or a ferrocenyl group or a substituted ferrocenyl group;

R^2 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of halogen, silicon, nitrogen, oxygen and sulfur atoms, or a ferrocenyl group or a substituted ferrocenyl group;

and R^1 and R^2 may form together a ring;

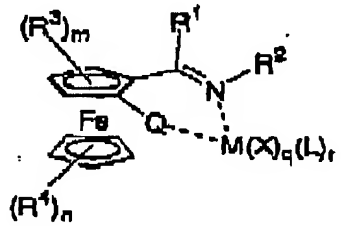
R^3 represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, oxygen, halogen and sulfur atoms and, when m is an integer of at least 2, R^3s may be the same as or different from each other, and adjacent R^3s may form together a ring;

R^4 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen, halogen and sulfur atoms; and, when n is an integer of at least 2, R^4s may be the same as or different from each other, and adjacent R^4s may form together a ring; and R^3 and R^4 may form together a ring;

L is a coordinate bond-forming compound selected from the group consisting of π electron, ethers, nitriles, amines and phosphines, and L may be bound to X;

m is an integer of 1 to 3, n is an integer of 1 to 5, q is an integer of 1 to 3 and r is an integer of 0 to 3.

3. A transition metal compound represented by the following formula (3):



(3)

wherein M represents a transition metal atom selected from the group consisting of metal atoms of group 3 to group 12 of the periodic table;

X represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbyloxygroup having 1 to 20 carbon atoms, an amino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a sulfonate group having an organic residue with 1 to 20 carbon atoms, or a non-coordinative anion containing an element selected from the group consisting of B, Al, P and Sb, and, when q is an integer of at least 2, Xs may be the same as or different from each other;

R^1 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one halogen atom, or a ferrocenyl group or a substituted ferrocenyl group;

R^2 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of halogen, silicon, nitrogen, oxygen and sulfur atoms, or a ferrocenyl group or a substituted ferrocenyl group; and R^1 and R^2 may form together a ring;

Q represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an amino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen and sulfur atoms, or oxygen or sulfur; and, when Q contains a coordinative atom, Q can be coordinatively bound to M;

R^3 represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group

having one or more hydrocarbon groups each with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, oxygen, halogen and sulfur atoms, and one of R^3s adjacent to Q may form a ring together with Q; and, when m is an integer of at least 2, R^3s may be the same as or different from each other, and adjacent R^3s may form together a ring;

R^4 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen, halogen and sulfur atoms; and, when n is an integer of at least 2, R^4s may be the same as or different from each other, and adjacent R^4s may form together a ring; and R^3 and R^4 may form together a ring; and, when R^4 contains a heteroatom, R^4 can coordinate with the transition metal atom M;

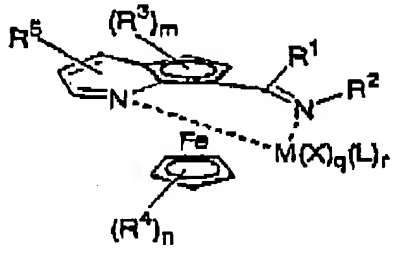
L is a coordinate bond-forming compound selected from the group consisting of π electron, ethers, nitriles, amines and phosphines, and L may be bound to X;

m is an integer of 1 to 3 and n is an integer of 1 to 5;

when Q is sulfur or oxygen, the bond between Q and M is a sigma bond; and

q is an integer of 1 to 3 and r is an integer of 0 to 3.

4. A transition metal compound represented by the following formula (4):



(4)

wherein M represents a transition metal atom selected from the group consisting of metals of group 3 to group 12 of the periodic table;

X represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a sulfonate group having an organic residue with 1 to 20 carbon atoms, or a non-coordinative anion containing an element selected from the group consisting of B, Al, P and Sb, and, when q is an integer of at least 2, Xs may be the same as or different from each other;

R^1 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a trifluoromethyl group, a ferrocenyl group or a substituted ferrocenyl group;

R^2 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of silicon, nitrogen, oxygen and sulfur atoms, or a ferrocenyl group or a substituted ferrocenyl group; and R^1 and R^2 may form together a ring;

R^3 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms or a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms; and, when m is an integer of at least 2, R^3s may be the same as or different from each other;

R^4 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen, halogen and sulfur atoms; and, when n is an integer of at least 2, R^4s may be the same as or different from each other, and adjacent R^4s may form together a ring;

R^5 represents a hydrogen atom, a hydrocarbon group having

1 to 20 carbon atoms or an amino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms;

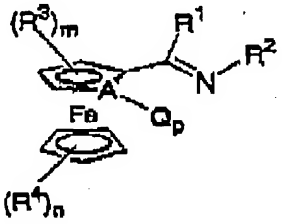
L is a coordinate bond-forming compound selected from the group consisting of π electron, ethers, nitriles, amines and phosphines, and L may be bound to X;

m is an integer of 1 or 2, n is an integer of 1 to 5, q is an integer of 1 to 3 and r is an integer of 0 to 3.

5. The transition metal compound according to any one of claims 1 to 4, wherein M represents a transition metal atom selected from the group consisting of metal atoms of group 8 to group 12 of the periodic table.

6. The transition metal compound according to any one of claims 1 to 4, wherein M represents a transition metal atom selected from the group consisting of Ni, Pd, Fe and Cu.

7. A coordinative compound represented by the following formula (5):



(5)

wherein A represents a carbon atom, a nitrogen atom or a phosphorus atom;

R^1 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one halogen atom, or a ferrocenyl group or a substituted ferrocenyl group;

R^2 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of halogen, silicon, nitrogen, oxygen and sulfur atoms, or a ferrocenyl group or a substituted ferrocenyl group; and R^1 and R^2 may form together a ring;

Q represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an amino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen and sulfur atoms, or a hydroxyl group or a thiol group;

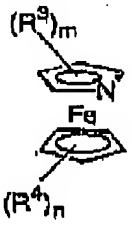
R^3 represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, oxygen, halogen and sulfur atoms and one of R^3s adjacent to Q may form a ring together with Q; and, when m is an integer of at least 2, R^3s may be the same as or different from each other, and adjacent R^3s may form together a ring;

R^4 represents a hydrogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen, halogen and sulfur atoms; and, when n is an integer of at least 2, R^4s may be the same as or different from each other, and adjacent R^4s may form together a ring; and R^3 and R^4 may form together a ring; and

m is an integer of 1 to 3, n is an integer of 1 to 5, and p is an integer of 0 or 1.

B. A compound which is a precursor to the coordinative

compound represented by formula (5) shown in claim 7, and which is represented by the following formula (6):



(6)

wherein R^3 represents a hydrogen atom, a halogen atom, a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, oxygen, halogen and sulfur atoms and, when m is an integer of at least 2, R^3s may be the same as or different from each other, and adjacent R^3s may form together a ring;

R^4 represents a hydrocarbon group having 1 to 20 carbon atoms, a silyl group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, a phosphino group having one or more hydrocarbon groups each with 1 to 20 carbon atoms, an oxy group having a hydrocarbon group with 1 to 20 carbon atoms, a thio group having a hydrocarbon group with 1 to 20 carbon atoms, or a hydrocarbon group having 1 to 20 carbon atoms and containing at least one atom selected from the group consisting of nitrogen, phosphorus, oxygen, halogen and sulfur atoms; and, when n is an integer of 1, R^4 is not a methyl group; and when n is an integer of at least 2, R^4s may be the same as or different from each other, and all of the R^4s are not simultaneously a methyl group; and adjacent R^4s may form together a ring; and R^3 and R^4 may form together a ring; and

m is an integer of 1 to 3 and n is an integer of 1 to 5.

9. A catalyst for polymerization of an olefin, which comprises the transition metal compound as claimed in any one of claims 1 to 4.

10. A catalyst for polymerization of an olefin, which comprises the transition metal compound as claimed in any one of claims 1 to 4, and an activating cocatalyst.

11. A process for polymerization of an olefin, which comprises polymerizing an olefin in the presence of a catalyst comprising the transition metal compound as claimed in any one of claims 1 to 4.

12. A process for polymerization of an olefin, which comprises polymerizing an olefin in the presence of a catalyst comprising the transition metal compound as claimed in any one of claims 1 to 4, and an activating cocatalyst.